Claims

[c1] 1. A process for removing SO_2, NO, and NO_2 from a gas stream comprising the steps of

a. oxidizing at least a portion of NO in a gas stream to NO_2 with an oxidizing means, followed by

b. scrubbing at least a portion of SO_2, NO, and NO_2 from the gas stream with a scrubbing solution

comprising ammonia, and

having a pH between 6 and 8, and

c. removing at least a portion of any ammonia aerosols generated from the scrubbing step from the gas stream with an aerosol removal means.

[c2] 2. The process of claim 1, wherein said oxidizing means is an electrical discharge reactor.

[c3] 3. The process of claim 2, wherein said electrical discharge reactor is a dielectric barrier discharge reactor.

[c4] 4. The process of claim 3, further comprising the step of oxidizing at least a portion of the NO to HNO_3 with said dielectric barrier discharge reactor.

[c5] 5. The process of claim 1, wherein said oxidizing step is adapted to result in a mole ratio of SO_2 to NO_2 of at least 2.5 to 1.

[c6] 6. The process of claim 1, wherein said oxidizing step is adapted to result in a mole ratio of SO_2 to NO_2 of at least four to one.

[c7] 7. The process of claim 1, said scrubbing solution

comprising ammonia, ammonium sulfite, ammonium sulfate, and water, and

having a pH between 6 and 8.

[c8] 8. The process of claim 1, wherein said aerosol removal means is a wet electrostatic precipitator.

[c9] 9. The process of claim 1, wherein said scrubbing step results in the formation

of ammonium sulfate, the process further comprising the step of withdrawing ammonium sulfate from the scrubbing solution.

[c10] 10.The process of claim 4, wherein said scrubbing step results in the formation of ammonium nitrate, the process further comprising the step of withdrawing ammonium nitrate from the scrubbing solution.

[c11] 11.A process for removing SO_2, NO, NO_2, and Hg from a gas stream comprising the steps of

a. oxidizing at least a portion of the NO in a gas stream to NO_2, and at least a portion of the Hg in a gas stream to HgO, with an oxidizing means, followed by

b. scrubbing at least a portion of the SO_2, NO, and NO_2 from the gas stream with a scrubbing solution

comprising ammonia, and

having a pH between 6 and 8, and

c. removing at least a portion of any ammonia aerosols generated from the scrubbing step, and HgO, from the gas stream with an aerosol removal means.

[c12] 12.The process of claim 11, wherein said oxidizing means is an electrical discharge reactor.

[c13] 13.The process of claim 12, wherein said electrical discharge reactor is a dielectric barrier discharge reactor.

[c14] 14.The process of claim 11, wherein said aerosol removal means is a wet electrostatic precipitator.

[c15] 15.The process of claim 11, said scrubbing solution
comprising ammonia, ammonium sulfite, ammonium sulfate, and water, and having a pH between 6 and 8.

[c16] 16.The process of claim 15, wherein said scrubbing step results in the formation of ammonium sulfate, the process further comprising the step of withdrawing ammonium sulfate from the scrubbing solution.

[c17] 17. An apparatus for removing SO_2, NO, and NO_2 from a gas stream comprising

a. an oxidizing means for oxidizing at least a portion of the NO in a gas stream to NO_2, followed by

b. a scrubber suitably adapted to scrub at least a portion of the SO_2, NO, and NO_2 from the gas stream with a scrubbing solution

comprising ammonia, and

having a pH between 6 and 8, and

c. an aerosol removal means for removing at least a portion of any ammonia aerosols generated by the scrubber from the gas stream.

[c18] 18.The apparatus of claim 17, wherein said oxidizing means is at least one electrical discharge reactor.

[c19] 19.The apparatus of claim 18, wherein said electrical discharge reactor is at least one dielectric barrier discharge reactor.

[c20] 20.The apparatus of claim 19, wherein said dielectric barrier discharge reactor is adapted to oxidize at least a portion of the NO to NO_2 and HNO_3.

[c21] 21.The apparatus of claim 17, said scrubbing solution comprising ammonia, ammonium sulfite, ammonium sulfate, and water, and having a pH between 6 and 8.

[c22] 22.The apparatus of claim 17, wherein said aerosol removal means is at least one wet electrostatic precipitator.

[c23] 23. An apparatus for removing SO_2, NO, NO_2, and Hg from a gas stream comprising

a. an oxidizing means for oxidizing at least a portion of the NO in a gas stream to NO_2, and at least a portion of the Hg in a gas stream to HgO, followed by

b. a scrubber suitably adapted to scrub at least a portion of the SO_2, NO, and NO_2 from the gas stream with a scrubbing solution

comprising ammonia, and

having a pH between 6 and 8, and

c. an aerosol removal means for removing at least a portion of any ammonia aerosols generated by the scrubber, and HgO, from the gas stream.

[c24] 24.An apparatus for removing SO_2, NO, and NO_2 from a gas stream comprising

a. an NO oxidizer adapted to oxidize at least a portion of the NO in a gas stream to NO_2, followed by

b. a scrubber adapted to scrub at least a portion of the SO_2, NO, and NO_2 from the gas stream with a scrubbing solution

comprising ammonia, and

having a pH between 6 and 8, and

c. an aerosol remover adapted to remove at least a portion of any ammonia aerosols generated by the scrubber from the gas stream.

[c25] 25.The apparatus of claim 24, wherein said NO oxidizer is at least one electrical discharge reactor.

[c26] 26.The apparatus of claim 25, wherein said electrical discharge reactor is at least one dielectric barrier discharge reactor.

[c27] 27.The apparatus of claim 26, wherein said dielectric barrier discharge reactor is adapted to oxidize at least a portion of the NO to NO_2 and HNO_3.

[c28] 28.T h apparatus of claim 24, said scrubbing solution comprising ammonia, ammonium sulfite, ammonium sulfate, and water, and having a pH between 6 and 8.

[c29] 29.The apparatus of claim 24, wherein said aerosol remover is at least one wet electrostatic precipitator.